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Risk factors for hospital-acquired and community-acquired pressure injuries: a multicentre mixed case–control study

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ABSTRACT

Objectives To separately examine and comprehensively compare the risk factors for hospital-acquired (HAPIs) and community-acquired pressure injuries (CAPIs).

Design A mixed case–control study.

Setting Four medical centres in China.

Participants Inclusion criteria included patients who were (1) aged ≥18 years on admission; (2) admitted between January 2014 and December 2018, and (3) diagnosed with HAPIs (cases) or with no HAPIs (controls) during hospitalisation in the HAPIs study, and confirmed with CAPIs (cases) or with no PIs (controls) on admission in the CAPIs study. The exclusion criteria were as follows: (1) admitted for childbirth, psychiatric reasons or rehabilitation; (2) admitted for observation; (3) transferred from another hospital and (4) confirmed to have suffered PIs from previous hospitalisations in the CAPIs study. In total, 320 cases and 1657 controls were included in the HAPIs study, and 1763 cases and 1786 controls were included in the CAPIs study.

Primary and secondary outcome measures The outcome variable was the occurrence of PIs.

Results The existence of PIs or scars from previous PIs on admission, presence of forced posture, use of medical devices and surgery during hospitalisation were found to be independent risk factors for HAPIs, as evidenced by the corresponding OR and 95% CI values of 51.931 (34.241 to 78.763), 2.006 (1.405 to 2.864), 3.226 (1.709 to 6.089) and 2.161 (1.452 to 3.215), respectively. Age, sex, Braden rating and diabetes were found to be independent risk factors for CAPIs, as evidenced by the corresponding OR and 95% CI values of 1.031 (1.026 to 1.036), 0.810 (0.698 to 0.941), 1.235 (1.167 to 1.307) and 2.059 (1.332 to 3.184), respectively.

Conclusions The existence of PIs or scars from previous PIs on admission, presence of forced posture, use of medical devices and surgery during hospitalisation are suggested to be included as independent items for the risk assessment of PIs, together with the Braden scale. The Braden rating plays different roles in the development of CAPIs and HAPIs.

Strengths and limitations of this study

- ► This is a mixed case–control study with a relatively large body of samples, including a 1:5 case–control study with hospital-acquired pressure injuries (HAPIs) as cases and a 1:1 case–control study with community-acquired PIs (CAPIs) as cases.
- ► It is the first to separately examine and comprehensively compare the risk factors for HAPIs and CAPIs using a single study protocol.
- ► There is a possible selection bias in the CAPIs study, since only patients admitted to hospital were eligible, but not those cared for at home.

INTRODUCTION

Pressure injuries (PIs) are localised damage to the skin and underlying soft tissues, usually over a bony prominence due to pressure or pressure combined with shear. PIs impair the quality of life of patients by increasing pain, morbidity, and mortality and excessively consume healthcare resources worldwide, with an estimated annual cost of US$11 billion.[1–4] PIs can be categorised as either hospital-acquired or community-acquired, based on their occurrence settings. The prevalence of hospital-acquired PIs (HAPIs) remains high, ranging from 2.3% to 23.9% in long-term care units and 6% to 18.5% in acute care settings worldwide.[5 6] The prevalence of community-acquired PIs (CAPIs) was reported to be 0.014% within an inner London borough, 0.8% among Chinese community-dwelling older people, and up to 7.4% in community-dwelling adults admitted to acute care.[7–9]

PIs treatment is 2.5 times more costly than prevention.[10] PIs prevention measures include risk factors and assessment, skin and soft tissue assessment and protection, nutritional support, appropriate support surfaces and repositioning.[11] Risk factors and risk assessment are primary of all preventive measures, for the level of risk for PIs determines subsequent prevention strategies.[12–14] Therefore, it is pivotal to use a valid and reliable assessment tool to identify high-risk patients and implement effective preventive measures on PIs. The Braden scale is currently

the most widely used worldwide, in addition to other PIs assessment scales such as the Norton scale, Waterlow scale and Jackson Cubbin scale.[15–18] The Braden scale measures six domains of a patient, including sensory perception and communication, skin moisture, activity, mobility, nutrition, and skin friction and shear. However, other domains or factors, such as the use of medical devices, surgery during hospitalisation, diabetes, existence of PIs or scars from previous PIs on admission, presence of forced posture and work experience of responsive nurses, were not measured by the Braden scale. Moreover, studies on the risk factors of CAPIs have rarely been reported. Here, a mixed case–control study was conducted in four medical centres to separately examine and comprehensively compare the risk factors for HAPIs and CAPIs and explore the roles of the Braden scale in preventing HAPIs and CAPIs.

THE STUDY

Study design and participants

This mixed case–control study was conducted in four medical centres from January 2014 to December 2018, including a 1:5 case–control study with HAPIs as cases and a 1:1 case–control study with CAPIs as case. The sample size of cases was calculated according to the following formulas: $n = (1+1/c)\,\bar{p}\,\bar{q}\,(U_\alpha + U_\beta)^2 / (p_1 - p_0)^2$; $\bar{p} = (p_1 + cp_0)/(1+c)$; $\bar{q} = 1 - \bar{p}$; $p_1 = p_0 OR/[1 + p_0(OR-1)]$; p_0 indicates the estimated exposure rate of the factor of interest in the controls; OR indicates the estimated OR of the factor of interest; and c indicates the ratio of control number to case number. In the study, Braden rating was considered the factor of most interest, and the exposure rate of high and very high Braden ratings was estimated at 0.40 in both types of controls. The case number was calculated to 307 for the HAPIs study, with the β of 0.10, α of 0.05, c of 5, estimated p_0 of 0.40 and estimated OR of 1.50; for the CAPIs study, the case number was calculated to 1431, with the β of 0.10, α of 0.05, c of 1, estimated p_0 of 0.40 and estimated OR of 1.30.

In the HAPIs study, patients diagnosed with HAPIs and who met the selection criteria were considered as cases; patients diagnosed with no HAPIs were considered as controls (figure 1). In the CAPIs study, patients who were confirmed with CAPIs and met the selection criteria were considered as cases; patients confirmed with no PIs were considered as controls (figure 2). Inclusion criteria included patients who were (1) aged ≥18 years on admission; (2) admitted between January 2014 and December 2018, and (3) diagnosed with HAPIs (cases) or with no HAPIs (controls) during hospitalisation in the HAPIs study, and confirmed with CAPIs (cases) or with no PIs (controls) on admission in the CAPIs study. The exclusion criteria were as follows: (1) admitted for childbirth, psychiatric reasons or rehabilitation; (2) admitted for observation; (3) transferred from another hospital, and (4) confirmed to have suffered PIs from previous hospitalisations in the CAPIs study. The clinical data of

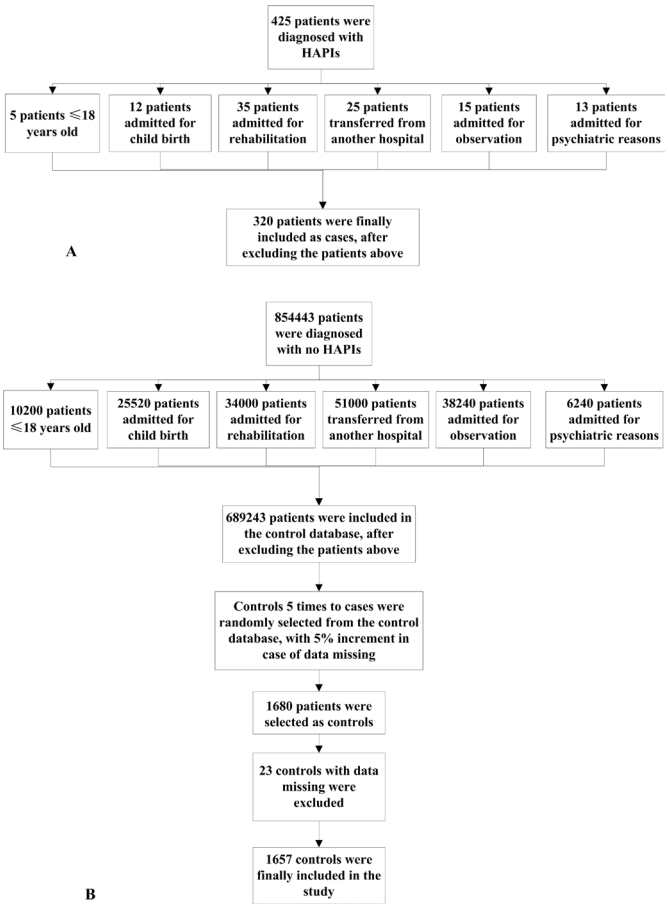

Figure 1 A flow diagram of the 1:5 case–control study for case (A) and control (B) selection. HAPIs, hospital-acquired pressure injuries.

both types of cases were extracted from the adverse event reporting and monitoring system and the electronic medical system. In total, 320 cases were included in the HAPIs study, and 1763 cases were included in the CAPIs study.

A control database meeting the selection criteria was obtained from the electronic medical system. Controls five times to cases and controls with the same number as cases, both with 5% increment in case of data missing, were separately and randomly selected from the database by a professional statistician for HAPIs and CAPIs studies, respectively. In total, 1657 controls were included in the HAPIs study, and 1786 controls were included in the CAPIs study. These methods adhered to the consolidated criteria for reporting case–control studies (Strengthening the Reporting of Observational Studies in Epidemiology).

Preventive measures for HAPIs in the studied medical centres

Every patient was carefully assessed for PIs risk by a nurse using the Braden scale on admission. The Braden scale, the most widely used scale developed by Barbara Braden and Nancy Bergstrom for risk assessment of PIs, was identified with moderate predictive validity.[16 17] It measures six domains: sensory perception and communication, skin moisture, activity, mobility, nutrition, and skin friction

Figure 2 A flow diagram of the 1:1 case–control study for case (A) and control (B) selection. CAPIs, community-acquired pressure injuries.

and shear. Based on Braden scores, patients were classified into five risk groups: very high risk, 6–9; high risk, 10–12; moderate risk, 13–14; at risk, 15–18; no risk, 19–23. Different risk groups were prescribed different preventive measures (figure 3).

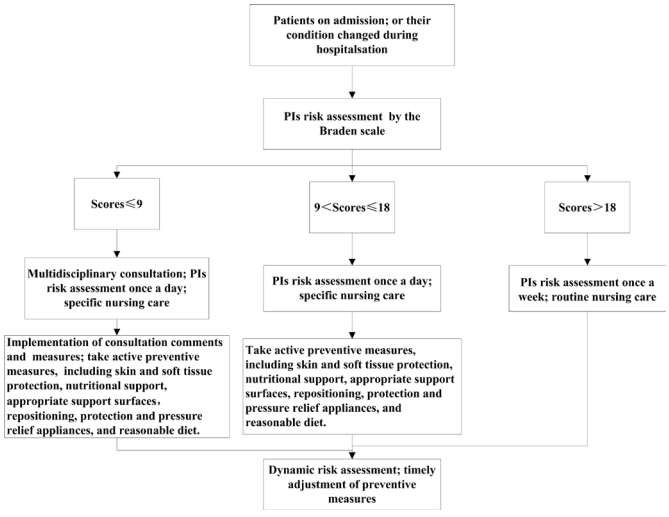

Figure 3 A flow diagram of preventive measures for PIs based on the Braden scale risk assessment. PIs, pressure injuries.

Patient and public involvement statement

The patients, public or any third parties were not involved in the design, conduct, reporting or dissemination of the research.

Outcome variable and potential relative factors

The outcome variable for the analyses was the occurrence of PIs. PIs were categorised as stages I, II, III, IV, deep tissue injury or unstageable. Unstageable PIs, as defined by the National Pressure Ulcer Advisory Panel (NPUAP), involve full-thickness tissue loss with the wound bed covered by slough or eschar that obscures accurate PI staging.[19 20] Clinical nurses evaluated PIs according to the International Pressure Ulcer Classification System (NPUAP, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance).[20 21] The potential related factors were (1) age; age was analysed as a continuous variable; (2) sex; female was encoded '1' and male was encoded '2' for analyses; (3) patient level of care (only for the HAPIs study); based on the patient's condition and self-care ability, the care level was divided into basic, moderate, intensive and very intensive degrees, which were respectively encoded '1', '2', '3' and '4' for analyses; (4) Braden rating; no risk, at risk, moderate risk and high/very high risk were respectively encoded '1', '2', '3' and '4' for analyses; (5) presence of forced posture (only for the HAPIs study); 'presence of postures that patients are forced to take to relieve the pain of diseases, including forced sitting posture, forced prone posture and forced side posture, etc.' was encoded '2,' and others were encoded '1' for analyses; (6) diabetes; a positive diagnosis of diabetes was encoded '2' and a negative diagnosis was encoded '1' for analyses; (6) use of medical devices (only for the HAPIs study); 'use of medical device causing pressure/shear at skin site, for example, O_2 mask, nasogastric tube' was encoded '2' and no use of medical devices was encoded '1' for analyses; (7) surgery during hospitalisation (only for the HAPIs study); undergoing surgery during hospitalisation was encoded '2' and not undergoing surgery was encoded '1' for analyses; (8) work experience of responsible nurses (only for the HAPIs study); '< 1 year', '≥1 and < 4 years', '≥4 and < 6 years', '≥6 and < 10 years' and '≥10 years' were respectively encoded '1', '2', '3', '4' and '5' for analyses; (9) existence of PIs or scars from previous PIs (only for the HAPIs study); 'existence of PIs or scars from previous PIs on admission' was encoded '2', and others were encoded '1' for analyses.

Data analyses

Normally distributed continuous variables are presented as means (SD), and non-normally distributed continuous variables are presented as medians (Q). Groups were compared using Student's t-test for normally distributed data and the Mann–Whitney U test for non-normally distributed data. Categorical data were presented as numbers and percentages (%) and compared using the χ^2 test or Fisher's exact test (if an expected value was ≤5).

Stepwise logistic regression models were used for multivariate analyses, and OR and 95% CI were used to express the association between each factor and PIs development. All statistical analyses were performed using R V.3.6.2 (http://www.r-project.org/). A two-sided p<0.05 indicates statistical significance.

RESULTS

Baseline characteristics and risk factors for HAPIs: univariate analyses

A total of 1977 patients were included in the study, including 1309 men (66.2%) and 668 women (33.8%), with a mean age of 69.69 (±15.62) years. A total of 320 patients were diagnosed with newly developed PIs during hospitalisation. Significant differences were found in the distributions of age, patient level of care, Braden rating, existence of PIs or scars from previous PIs on admission, presence of forced posture, use of medical devices, surgery during hospitalisation and work experience of responsible nurses between the HAPI and HAPI-free groups (p<0.05; table 1).

Risk factors for HAPIs: multivariate analyses

The associations between HAPIs and the variables of age, sex, patient level of care, Braden rating, existence of PIs or scars from previous PIs on admission, presence of forced posture, diabetes, use of medical devices,

Table 1 Univariate analyses results for factors related to HAPIs

Relative factors	HAPI group (n=320)	HAPI-free group (n=1657)	OR (95% CI)	Statistics	P value
Age (year), mean±SD	64.36±17.55	70.70±15.02	0.977 (0.970 to 0.984)	6.014	<0.001
Male, n (%)	227 (70.9)	1082 (65.3)	1.297 (0.999 to 1.685)	3.785	0.052
Patient level of care, n (%)					
Very intensive	111 (34.7)	286 (17.3)	1.304 (1.109 to 1.533)	10.257	0.001
Intensive	125 (39.1)	998 (60.2)			
Moderate	69 (21.6)	269 (16.2)			
Basic	15 (4.7)	104 (6.3)			
Braden rating, n (%)					
No risk	70 (21.9)	309 (18.7)	0.809 (0.736 to 0.890)	19.322	<0.001
At risk	59 (18.4)	135 (8.1)			
Moderate risk	45 (14.1)	198 (11.9)			
High/very high risk	146 (45.6)	1015 (61.2)			
Existence of PIs or scars from previous PIs on admission, n (%)					
Positive	180 (56.3)	35 (2.1)	59.584 (39.865 to 88.989)	811.027	<0.001
Negative	140 (43.8)	1622 (97.9)			
Presence of forced posture, n (%)					
Positive	95 (29.7)	298 (18.0)	1.926 (1.469 to 2.524)	23.118	<0.001
Negative	225 (70.3)	1359 (82.0)			
Diabetes, n (%)					
Positive	12 (3.8)	40 (3.6)	1.037 (0.551 to 1.950)	0.013	0.909
Negative	308 (96.3)	1597 (96.4)			
Use of medical devices, n (%)					
Yes	53 (16.6)	40 (2.4)	8.029 (5.221 to 12.349)	119.861	<0.001
No	267 (83.4)	1617 (97.6)			
Surgery during hospitalisation, n (%)					
Yes	94 (29.4)	170 (10.3)	3.638 (2.727 to 4.853)	59.477	<0.001
No	226 (70.6)	1487 (89.7)			
Work experience of responsible nurses, n (%)					
<1	28 (8.8)	94 (5.7)			
≥1 and < 4	87 (27.2)	421 (25.4)			
≥4 and < 6	92 (28.8)	452 (27.3)	0.885 (0.798 to 0.983)	5.129	0.023
≥6 and < 10	70 (21.9)	436 (26.3)			
≥10	43 (13.4)	254 (15.3)			

N=1977.
HAPIs, hospital-acquired pressure injuries; PIs, pressure injuries.

Table 2 Multivariate regression analyses results for factors related to HAPIs

Risk factors	B	SE	Waldχ^2	P value	OR (95% CI)
Existence of PIs or scars from previous PIs on admission	3.950	0.213	345.470	<0.001	51.931 (34.241 to 78.763)
Presence of forced posture	0.696	0.182	14.678	<0.001	2.006 (1.405 to 2.864)
Use of medical devices	1.171	0.324	13.062	<0.001	3.226 (1.709 to 6.089)
Surgery during hospitalisation	0.771	0.203	14.444	<0.001	2.161 (1.452 to 3.215)

N=1977. Existence of PIs or scars from previous PIs on admission (1=negative; 2=positive). Presence of forced posture (1=negative, 2=positive). Use of medical devices (1=no use of medical devices; 2=use of medical devices). Surgery during hospitalisation (1=not undergoing surgery, 2=undergoing surgery).
HAPIs, hospital-acquired pressure injuries; PIs, pressure injuries.

surgery during hospitalisation and work experience of responsible nurses were explored using stepwise logistic regression analyses. The existence of PIs or scars from previous PIs on admission, presence of forced posture, use of medical devices and surgery during hospitalisation were found to be independent risk factors for HAPIs, as evidenced by the corresponding OR and 95% CI values of 51.931 (34.241 to 78.763), 2.006 (1.405 to 2.864), 3.226 (1.709 to 6.089) and 2.161 (1.452 to 3.215), respectively (table 2).

Baseline characteristics and risk factors for CAPIs: univariate analyses

A total of 3549 patients were included in the study, including 2458 men (69.3%) and 1091 women (30.7%), with a mean age of 69.69 (±15.62) years. A total of 1763 patients were diagnosed with CAPIs. Significant differences were found in the distributions of age, sex, Braden rating and diabetes between the CAPI and CAPI-free groups (p<0.05; table 3).

Related factors for CAPIs: multivariate analyses

The associations between CAPIs and variables of age, sex, Braden rating and diabetes were explored using stepwise logistic regression analyses. Age, sex, Braden rating and diabetes were found to be independent risk factors for CAPIs, as evidenced by the corresponding OR and 95% CI values of 1.031 (1.026 to 1.036), 0.810 (0.698 to 0.941), 1.235 (1.167 to 1.307) and 2.059 (1.332 to 3.184), respectively (table 4).

Distribution of PIs on the body

Both CAPIs and HAPIs were analysed in patients to describe their distributions throughout the body. A total of 2184 PIs were identified: 1141 (52.2%) were localised on the skin and underlying soft tissue over the tail sacral vertebrae, 454 (20.8%) were localised over the femoral trochanter, 294 (13.5%) over the ankle, 207 (9.5%) over the sciatic, 35 (1.6%) over the scapula, 31 (1.4%) over the calcaneus and 22 (1.0%) over the occipital.

DISCUSSION

A 1:5 case–control study with HAPIs as cases and a 1:1 case–control study with CAPIs as cases were conducted using a single study protocol. There were two main differences between the backgrounds of the two studies. First, in the HAPIs study, all patients were clinically assessed for the risk of PIs by responsible nurses using the Braden scale and were categorised into different risk groups based on their Braden scores. Corresponding preventive

Table 3 Univariate analyses results for factors related to CAPIs

Relative factors	CAPI group (n=1763)	CAPI-free group (n=1786)	OR (95% CI)	Statistics	P value
Age (year), mean±SD	70.59±15.15	62.29±17.40	1.030 (1.022 to 1.038)	15.027	<0.001
Male, n (%)	1157 (65.6)	1270 (71.1)	0.883 (0.824 to 0.945)	12.332	<0.001
Braden rating, n (%)					
No risk	330 (18.7)	415 (23.2)	1.257 (1.190 to 1.327)	68.306	<0.001
At risk	152 (8.6)	349 (19.5)			
Moderate risk	219 (12.4)	199 (11.1)			
High/very high risk	1062 (60.2)	823 (46.1)			
Diabetes, n (%)					
Positive	68 (3.9)	32 (1.8)	1.383 (1.205 to 1.590)	13.821	<0.001
Negative	1695 (96.1)	1754 (98.2)			

N=3549.
CAPIs, community-acquired pressure injuries.

Table 4 Multivariate regression analysis results for factors related to CAPIs

Risk factors	B	SE	Wald χ^2	P value	OR (95% CI)
Age	0.031	0.002	184.777	<0.001	1.031 (1.026 to 1.036)
Sex (male vs female)	−0.210	0.076	7.607	0.006	0.810 (0.698 to 0.941)
Braden rating	0.211	0.029	53.134	<0.001	1.235 (1.167 to 1.307)
Diabetes	0.722	0.222	10.559	0.001	2.059 (1.332 to 3.184)

N=3549. Sex (1=female; 2=male). Braden rating (1=no risk, 2=at risk, 3=moderate risk and 4=high/very high risk). Diabetes (1=negative, 2=positive).
CAPIs, community-acquired pressure injuries.

measures were then taken according to their PI risk levels (figure 3). However, in the CAPIs study, patients were only assessed using the Braden scale for risk evaluation, with no preventive measures. Second, caregivers in the HAPIs study were clinical nurses, while those in the CAPIs study were mainly community healthcare givers or patients' family members. There were significant differences in the knowledge, attitude and practices regarding PIs between the two healthcare groups. A cross-sectional study of community healthcare givers showed that the percentage of correct answers regarding knowledge was only 30.7%, even lower regarding the theme 'Prevention', in the studied community nurses.[22] However, another cross-sectional study regarding clinical nurses showed that the overall mean knowledge score was 65%; approximately two-thirds of the sample (68%) scored 60% and greater.[23] Understanding the differences in the study background helps to understand the divergences of risk factors for HAPIs and CAPIs.

Same risk factors playing different roles in the development of HAPIs and CAPIs

In univariate analyses, age, sex and Braden rating played different roles in developing HAPIs and CAPIs. In the CAPIs study, age was significantly associated with CAPIs development; older patients were more likely to develop PIs in the community, as evidenced by the OR and 95% CI of 1.030 (1.022 to 1.038). However, the HAPIs study found that older patients were less likely to develop HAPIs during hospitalisation, with an OR of 0.977. Most of the previous studies considered older age as a significant risk factor for PIs in hospital settings, as opposed to the findings of the HAPIs study.[6 24 25] One of the possible explanations is that older patients, as commonly considered a risk factor for PIs, probably raised more attention and more nursing care from clinical staff, which further reduced the development of PIs. Males were more likely than females to suffer from HAPIs and less likely than females to suffer from CAPIs in this study. The discrepancy also existed in another two studies, which reported either male or female sex as a risk factor of PIs in hospital settings.[26 27]

Braden rating was considered an independent risk factor for CAPIs; patients with higher Braden ratings (or lower Braden scores) were at a higher risk of developing PIs in the community, as evidenced by the OR and 95% CI of 1.257 (1.190 to 1.327). However, higher Braden ratings were associated with a lower likelihood of developing HAPIs, as evidenced by the OR and 95% CI of 0.809 (0.736 to 0.890). Some previous studies showed that lower Braden scores were associated with a higher risk of HAPIs.[28 29] This finding of the HAPIs study seemed contradictory to those of the CAPIs study and other previous studies, but it was reasonable concerning the study background. Although higher Braden ratings indicated higher risks for PIs, in the HAPIs study, higher Braden ratings also corresponded to more stringent preventive measures for PIs, as shown in figure 3, which further led to less PIs development. However, in the CAPIs study, preventive measures corresponding to Braden ratings were not applied to the patients; moreover, the knowledge, attitude and practices regarding PIs were considerably lower in the community healthcare givers than the clinical nurses, and the community healthcare givers usually failed to take adequate measures for PIs prevention.[22 23] The findings above suggested that the Braden Scale was capable of predicting the risk of PIs and was a relatively effective scale for PIs prevention together with the corresponding preventive measures. The above findings also suggested that the Braden Scale had a moderate but not very good predictive validity, as other studies identified,[16 17] as patients with lower Braden ratings tended to develop more PIs in the HAPIs study, even given the corresponding preventive measures (figure 3). We speculated that some patients identified with low Braden ratings in the HAPIs study might have other independent risk factors for PIs and were not supplied with adequate preventive measures only based on their Braden ratings.

Divergences of risk factors for HAPIs and CAPIs

Diabetes was considered an independent risk factor for CAPIs, as evidenced by the OR and 95% CI of 2.059 (1.332 to 3.184). Previous studies conducted in the intensive care unit also found that diabetes was positively associated with the occurrence of PIs.[28 29] Compared with CAPIs, there were some specific risk factors for HAPIs. The existence of PIs or scars from previous PIs on admission was the most significant risk factor for HAPIs, with an OR of 51.93. These results indicate that patients with existing PIs or scars from previous PIs are probably much more likely to develop HAPIs than those without, as existing PIs or scars from previous PIs usually mean persistent skin

vulnerability to pressure. This result is consistent with the Pressure Ulcer Risk Primary or Secondary Evaluation Tool, which includes this factor as the most significant.[30] In the study, 52.2% of PIs were localised on the skin and underlying soft tissue over the tail sacral vertebrae, followed by 20.8% over the femoral trochanter and 13.5% over the ankle. These findings suggest that the skin and underlying soft tissue over the tail sacral vertebrae should be the first localisation to check for PIs risk.

The presence of forced posture, use of medical devices and surgery during hospitalisation were also found to be independent risk factors for HAPIs, with corresponding ORs of 2.006, 3.226 and 2.161, respectively. Forced postures are postures that patients are forced to take to relieve the pain of diseases, including forced sitting posture, forced prone posture and forced side posture. It is typically difficult for nurses and clinicians to intervene, and the lack of active and passive repositioning, activity and mobility significantly increases the risk of HAPIs. Regarding the use of medical devices, Bly *et al* found that patients with feeding tubes were 5.68-fold more likely than those without feeding tubes to suffer HAPIs[31]; Cox and Roche reported that mechanical ventilation >72 hours was a significant risk factor for HAPIs, with an OR of 23.604.[32] With regard to surgery during hospitalisation, a systematic review reported that the average incidence of surgery-related PIs was 15%, and another literature review reported that the incidence of PIs in postoperative patients in intensive care units was up to 60%.[33 34] Patients undergoing surgeries were found to be 2.161-fold more likely than those not undergoing surgeries to suffer HAPIs in the study. Preoperative fasting and body stress are probably attributable to the development of HAPIs in surgical patients.

In the univariate analyses, greater work experience of responsible nurses was considered a protective factor for HAPIs, with an OR of 0.885. Nurses with more work experience usually have more skills and experience in treating and preventing PIs. In the univariate analyses of the HAPIs study, patient level of care was a risk factor, with an OR of 1.304. The higher the level of care, the more complex and serious the patient's condition. Considering the competing risks of the existence of PIs or scars from previous PIs on admission, presence of forced posture, use of medical devices and surgery during hospitalisation, the association between Braden rating and HAPIs development became non-significant in the multivariate analyses. These findings suggest that these factors should be included as independent items for the risk assessment of PIs together with the Braden scale.

Limitations

This study had some limitations. First, cases in the CAPIs study were community-dwelling adults admitted to hospital care who were identified with PIs that occurred in the communities. It is not a value of all people with PIs at home in the communities, for patients who did not go to hospitals were omitted. The cases in the CAPIs study may be more severe and complicated than those not admitted to hospitals, and selection bias should be considered when interpreting the study results. Second, not all potential risk factors were included in the analyses; further studies on other probable risk factors for both CAPIs and HAPIs are expected.

Overall, the existence of PIs or scars from previous PIs on admission, presence of forced posture, use of medical devices and surgery during hospitalisation are significant risk factors for HAPIs, besides Braden rating, and are suggested to be included as independent items for the risk assessment of PIs, together with the Braden scale. The Braden rating plays different roles in the development of CAPIs and HAPIs.

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